

FIGURE 2. Diagram of Nontransferred Plasma Torch with Rapid Quench Reactor, Particle Trap, and Liquid N<sub>2</sub> Trap.

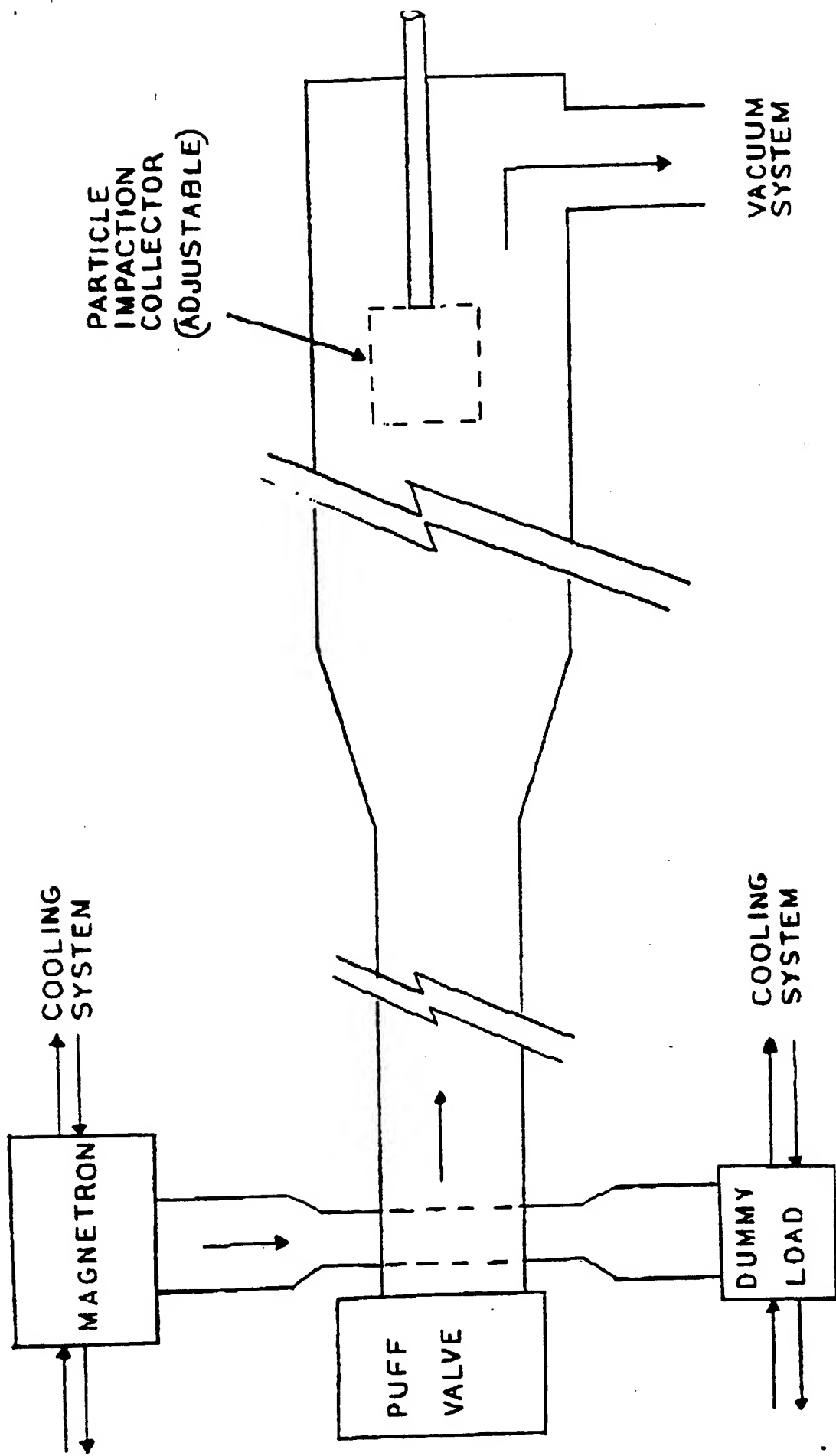


Fig 6

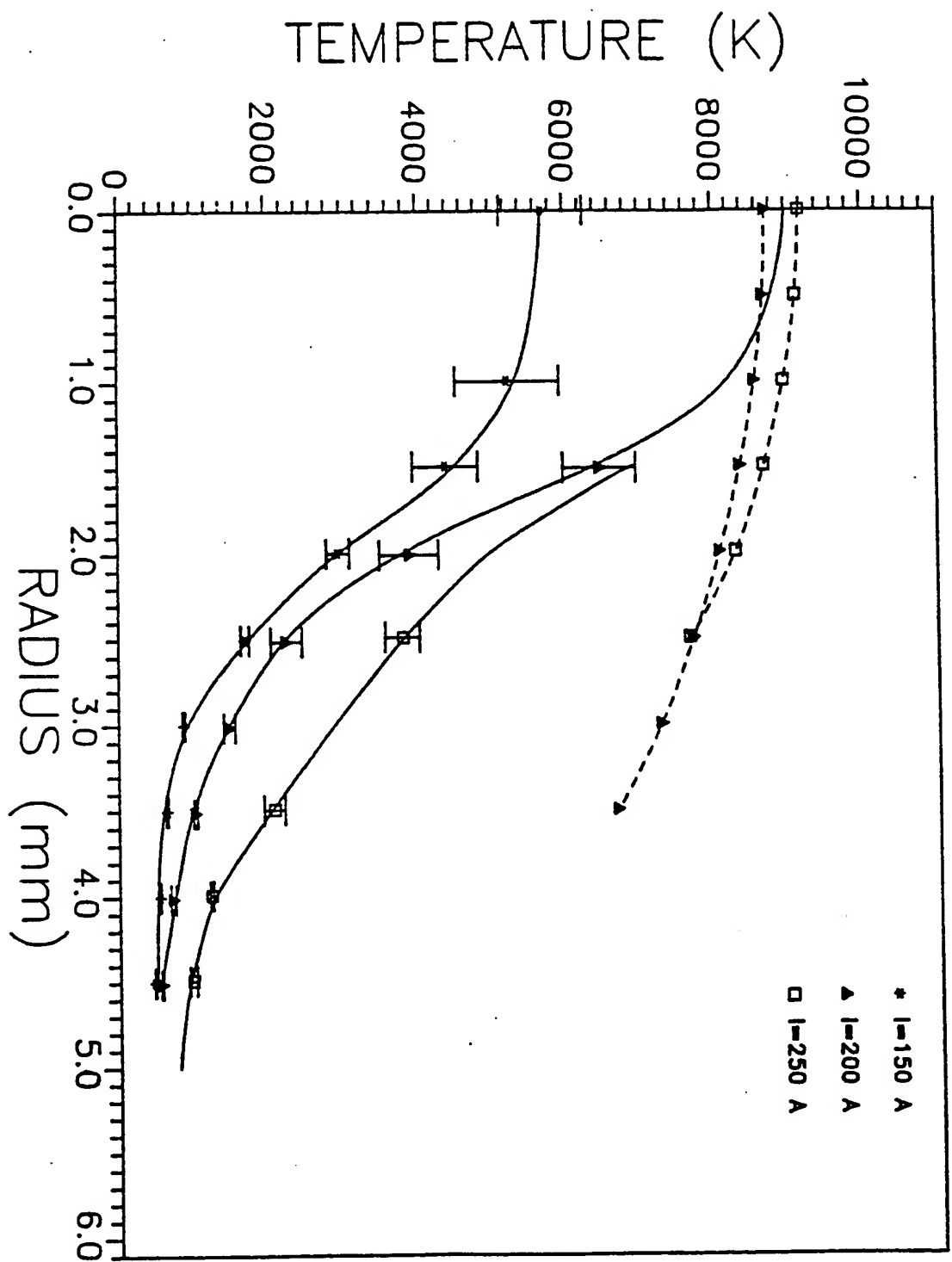
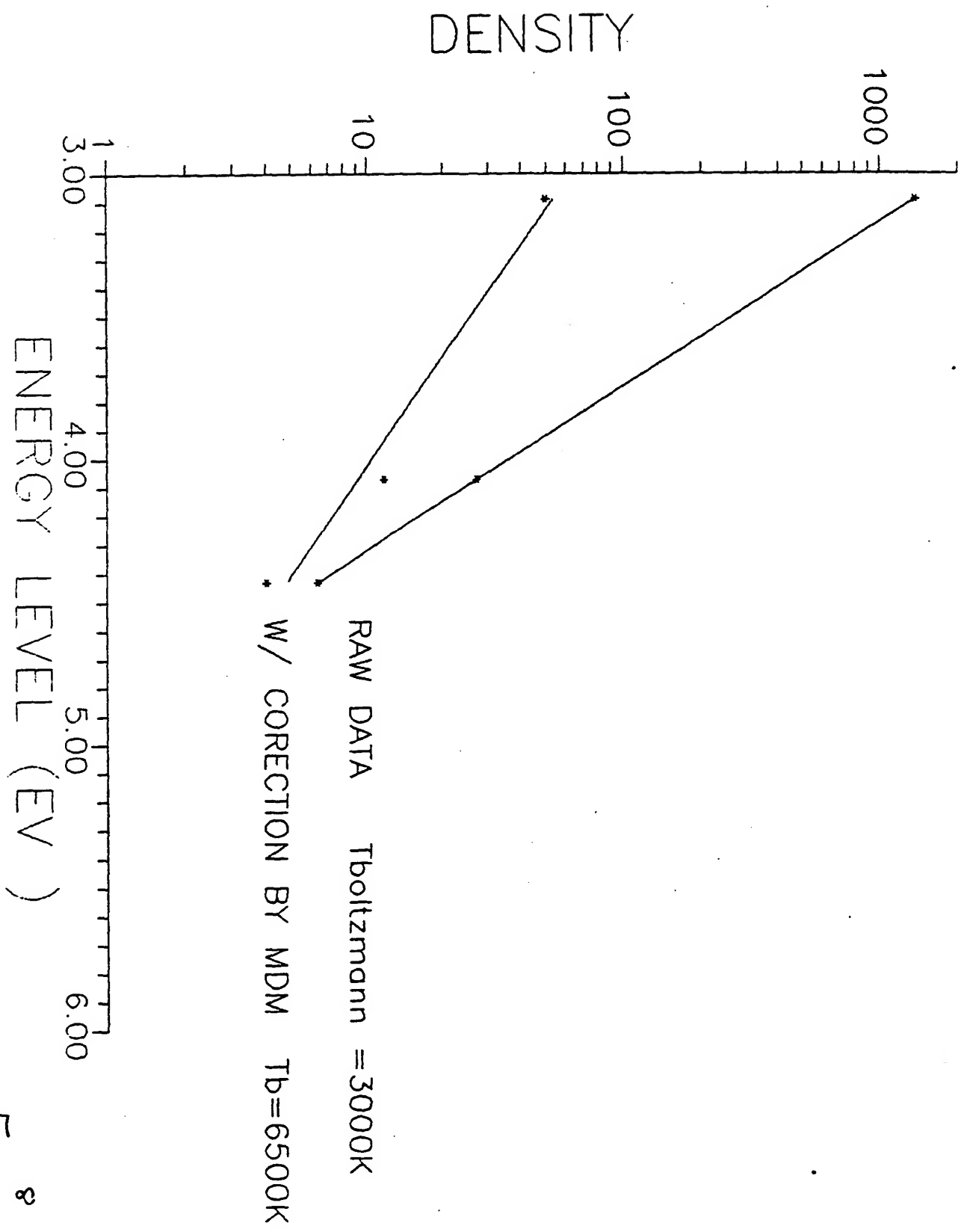
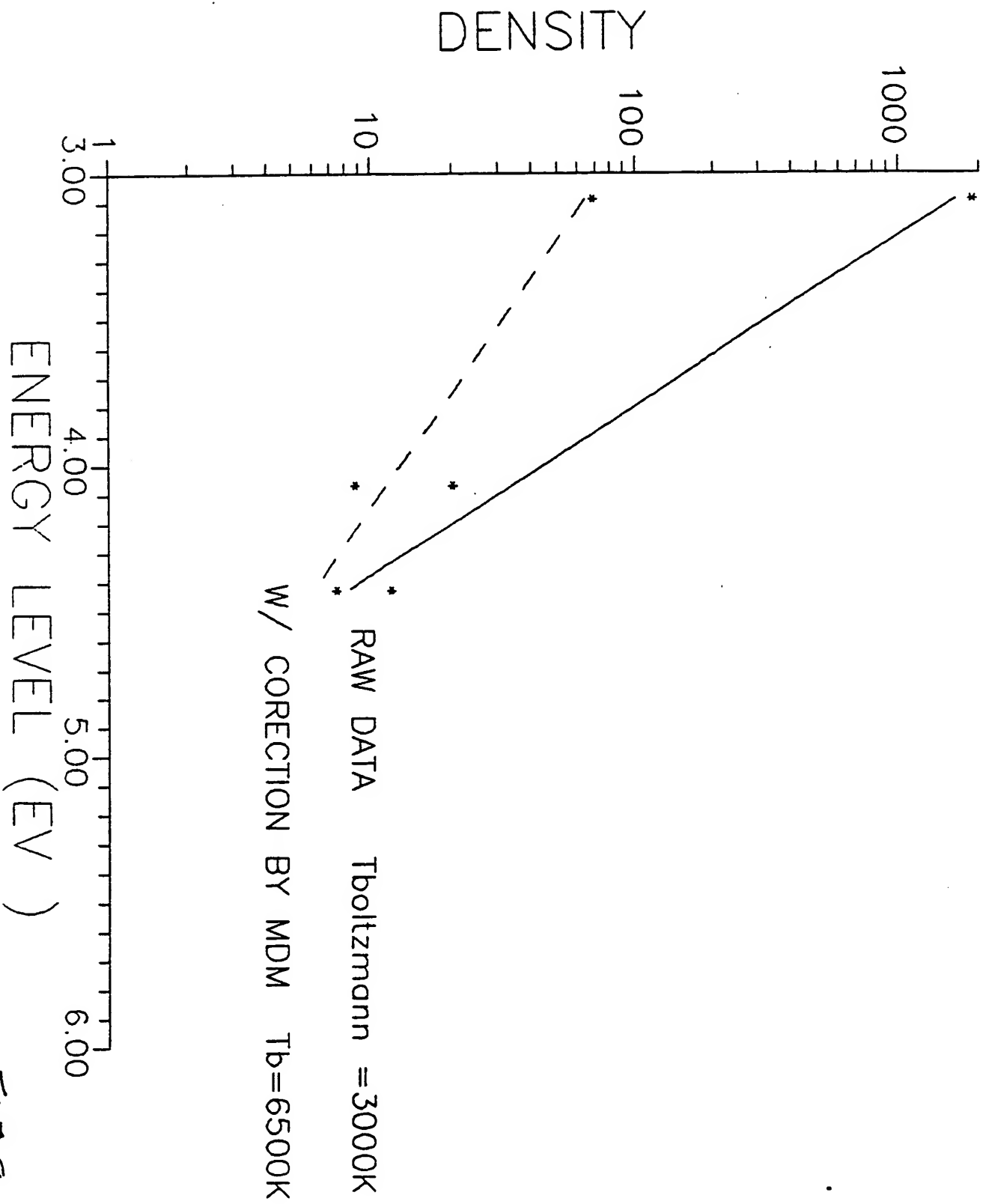
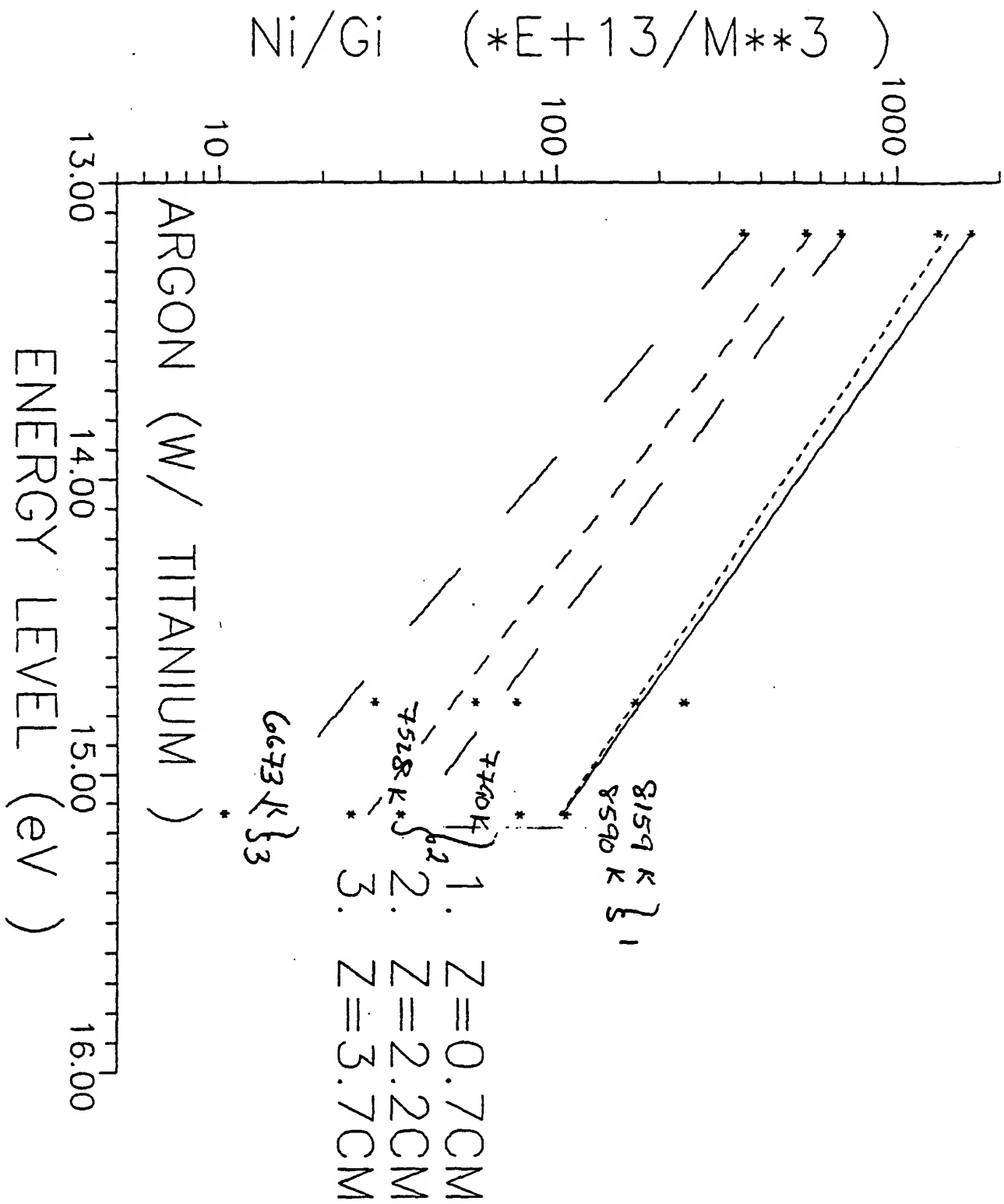


Fig. 7







Curve 724401-A

Case #10

Ar: H<sub>2</sub>: Ti = 1: 10: 1

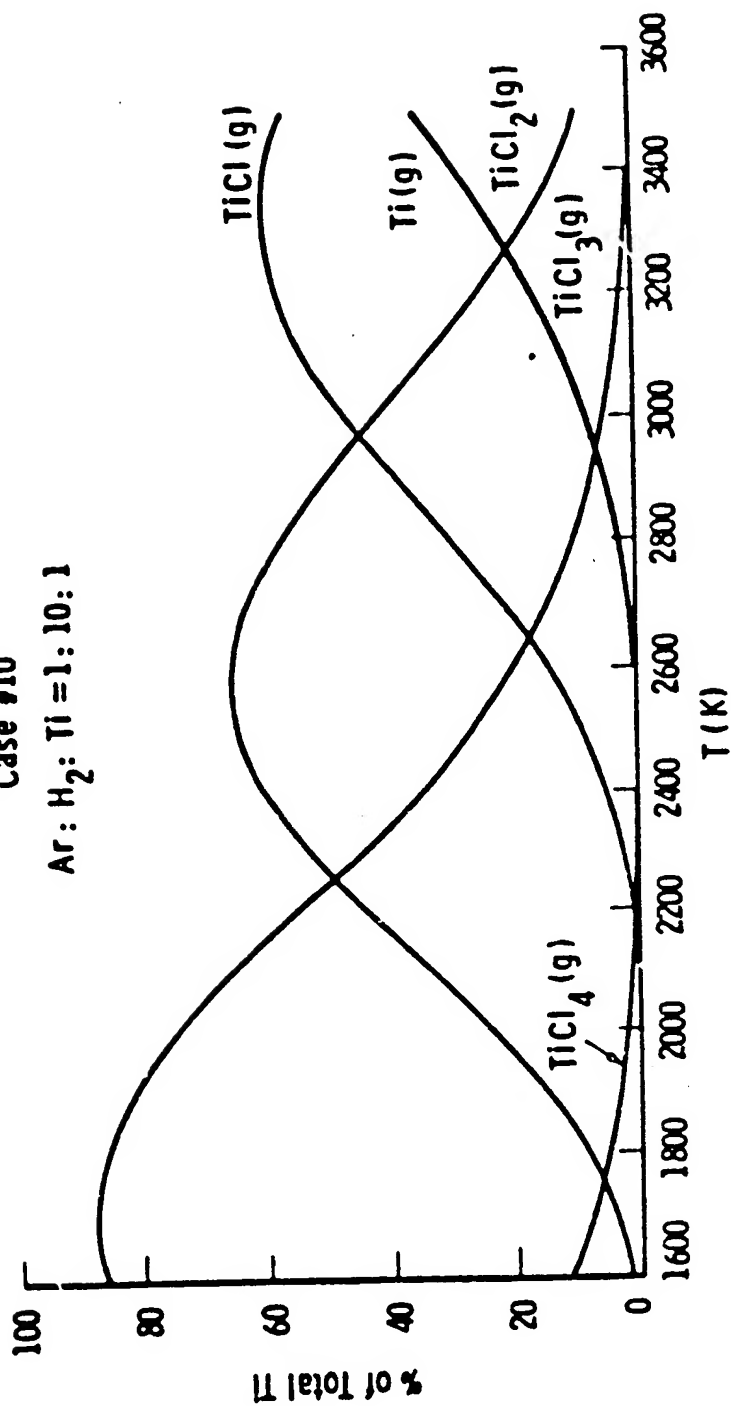


Fig. 1—Thermochemical equilibrium for the hydrogen reduction of TiCl<sub>4</sub>

Curve 724393-A

Case #18

$H_2$ : Ar: Na: Ti: Cl = 13:4: 3: 35: 4: 1: 4

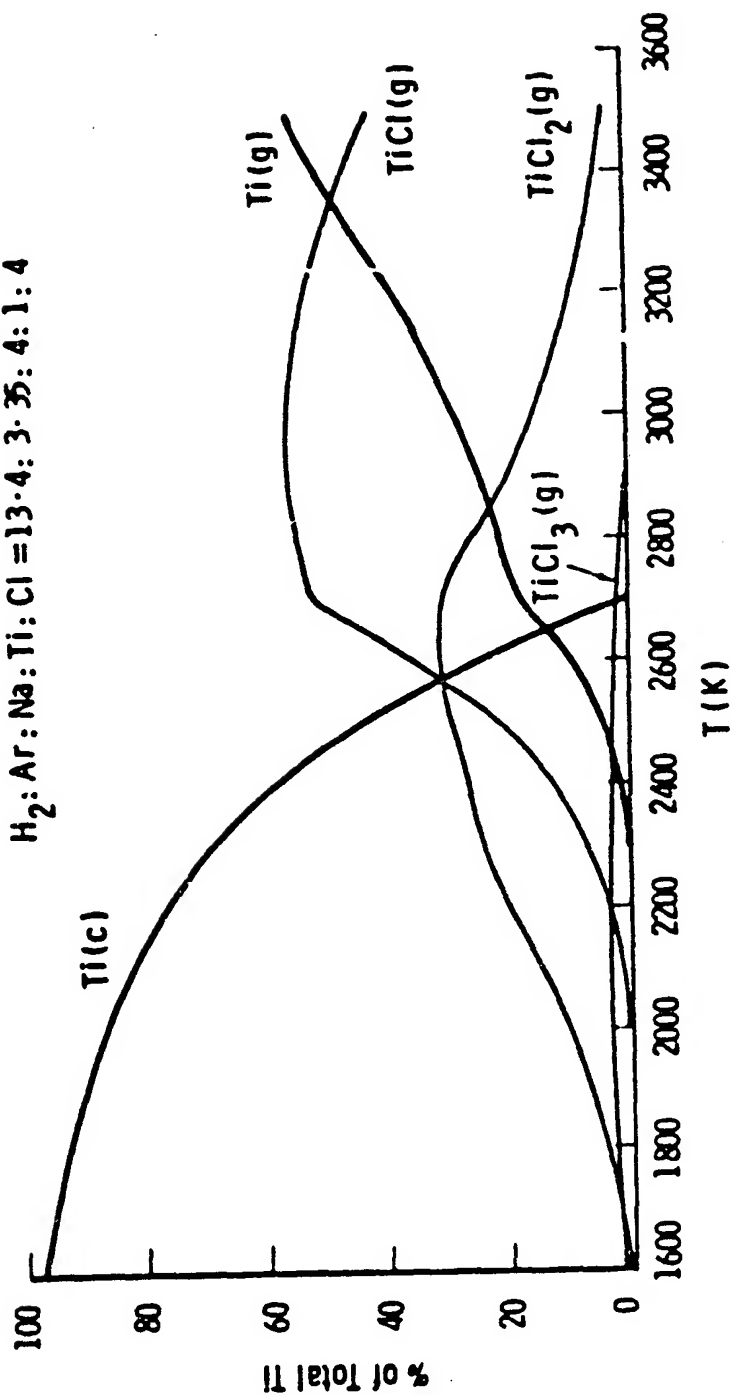


Fig. 2—Thermochemical equilibrium for the sodium/hydrogen reduction of  $TiCl_4$



Curve 724395-A

Case #19

$H_2 : Ar : Na : Ti : Cl = 13.4 : 3.35 : 8 : 1 : 4$

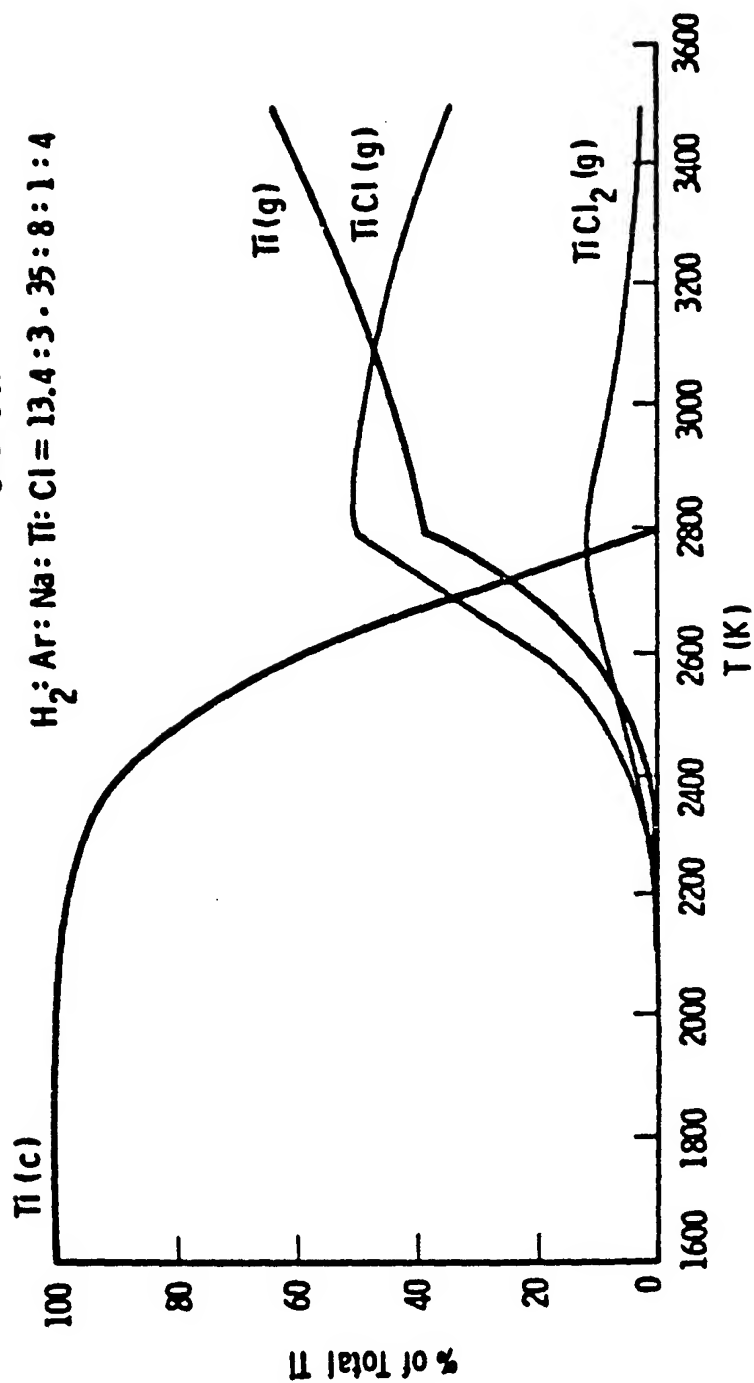


Fig. 3--Thermochemical equilibrium for the sodium/hydrogen reduction of  $TiCl_4$  (excess sodium)

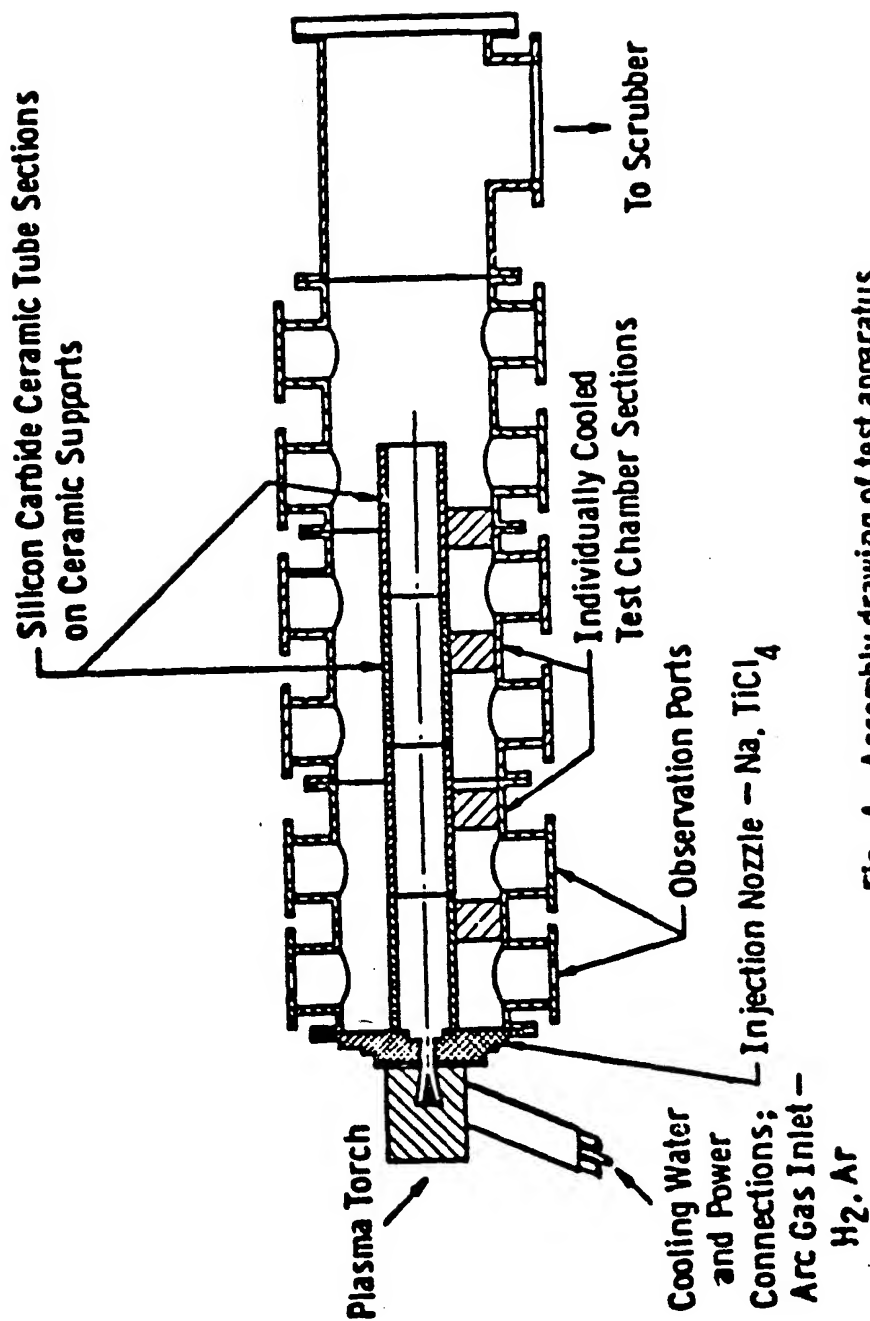


Fig. 4 - Assembly drawing of test apparatus

Doc. 2622C44

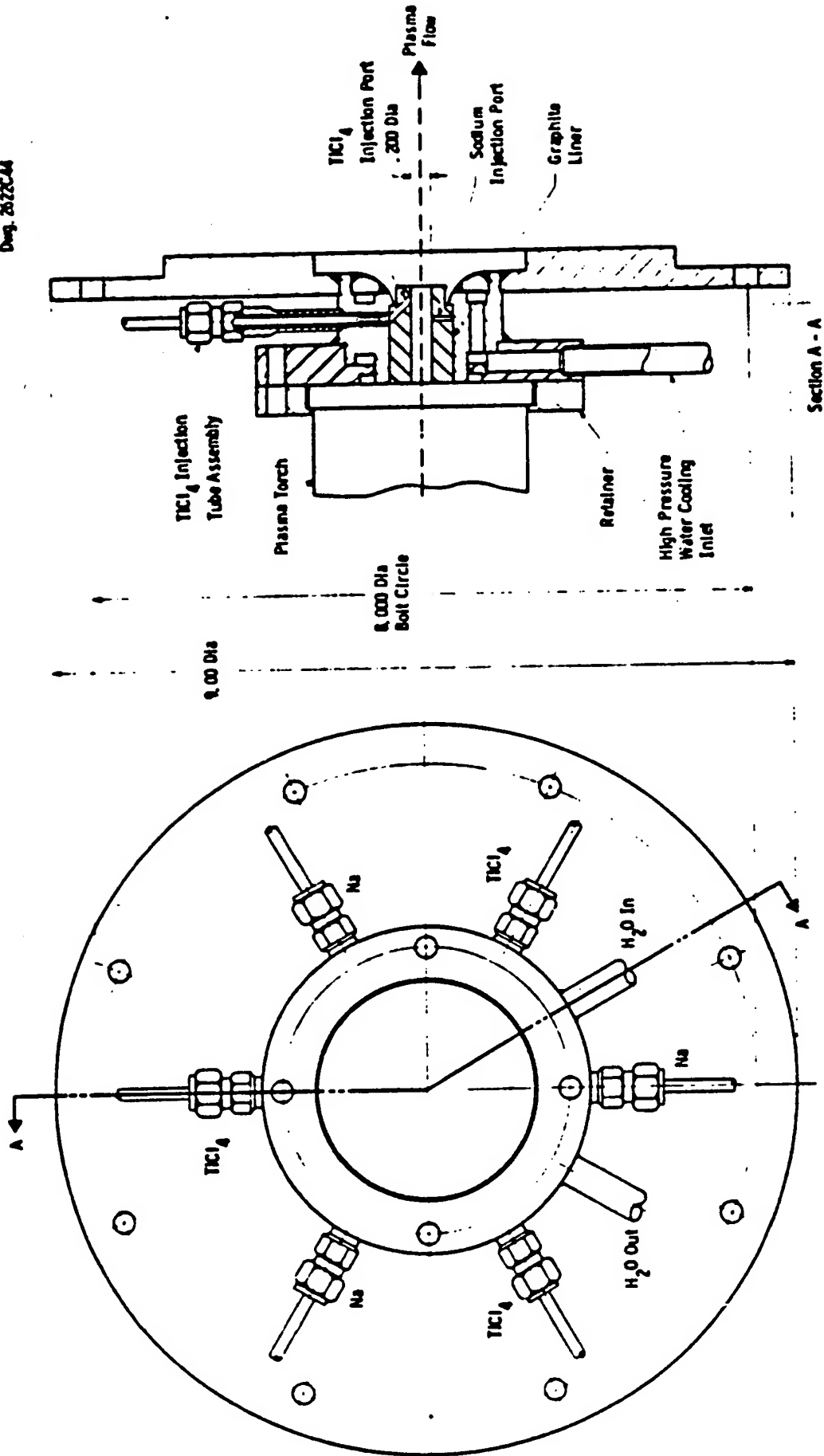


Fig. 5-Reactant Injection nozzle



Figure 6 — Laboratory-scale 40 kW plasma reactor used to produce high quality titanium.



Figure 7. Photograph of Experimental Apparatus

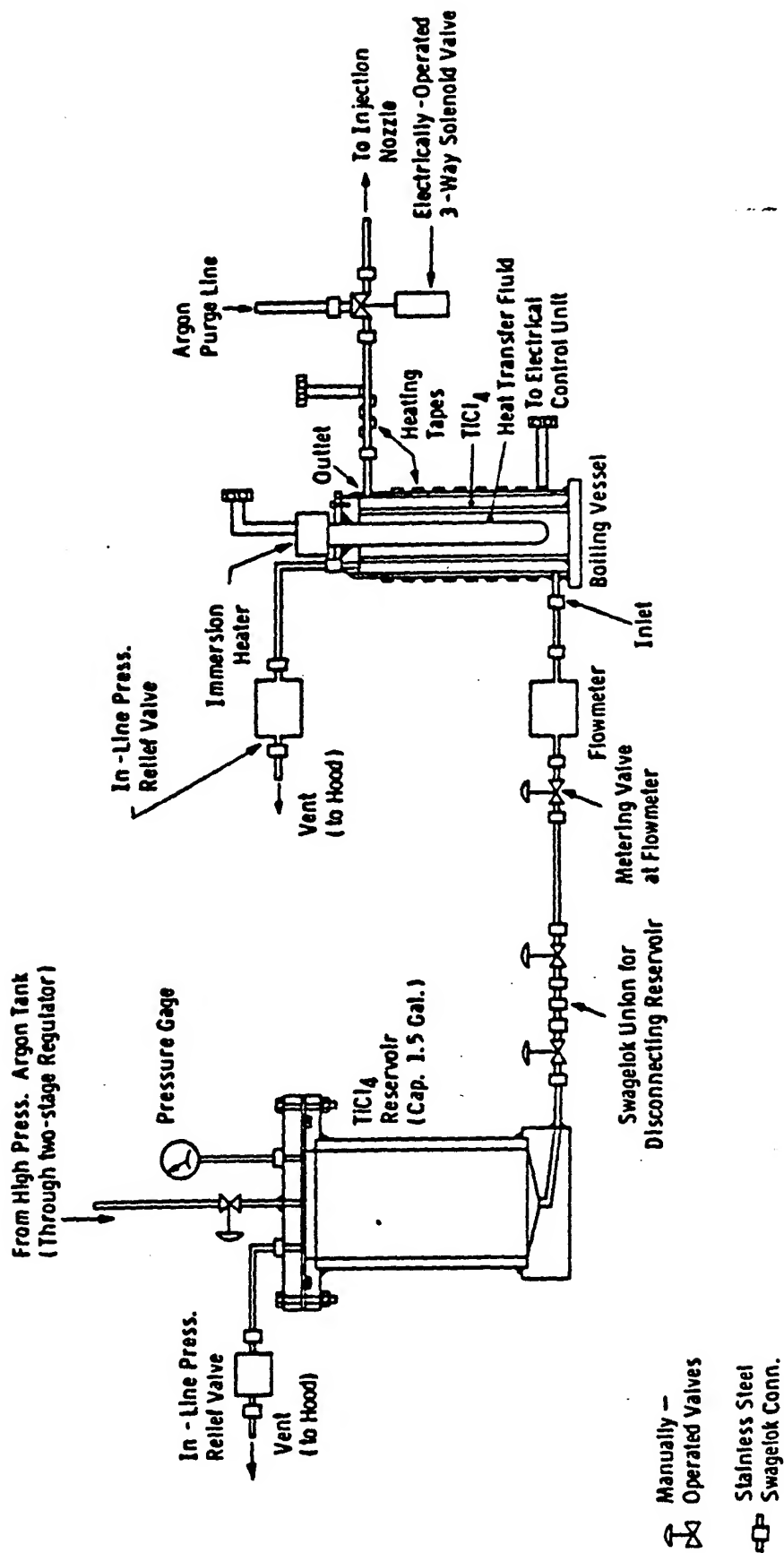


Fig. 8—Schematic of the TiCl<sub>4</sub> supply system

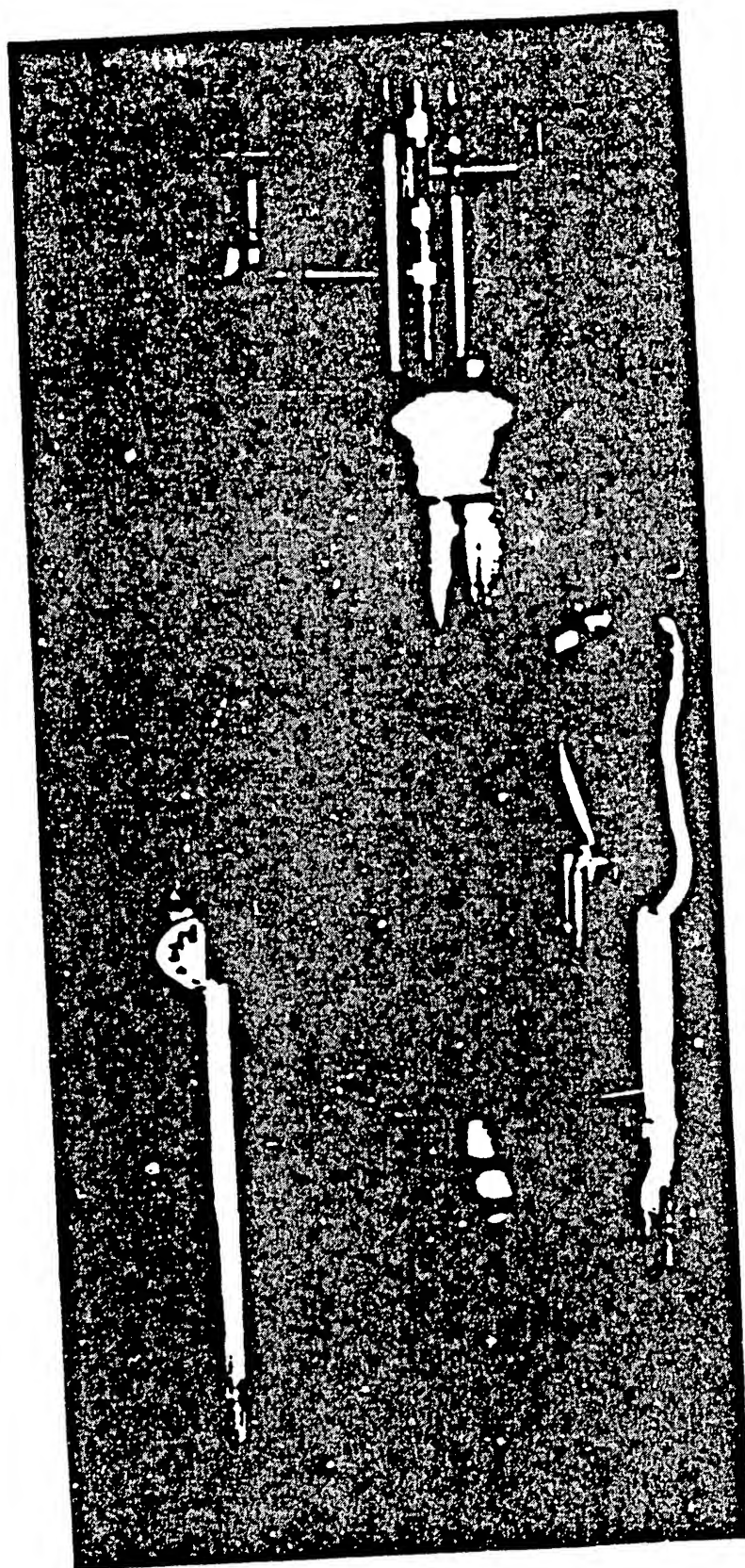


Figure 9. Photograph of the Sodium Storage Tank

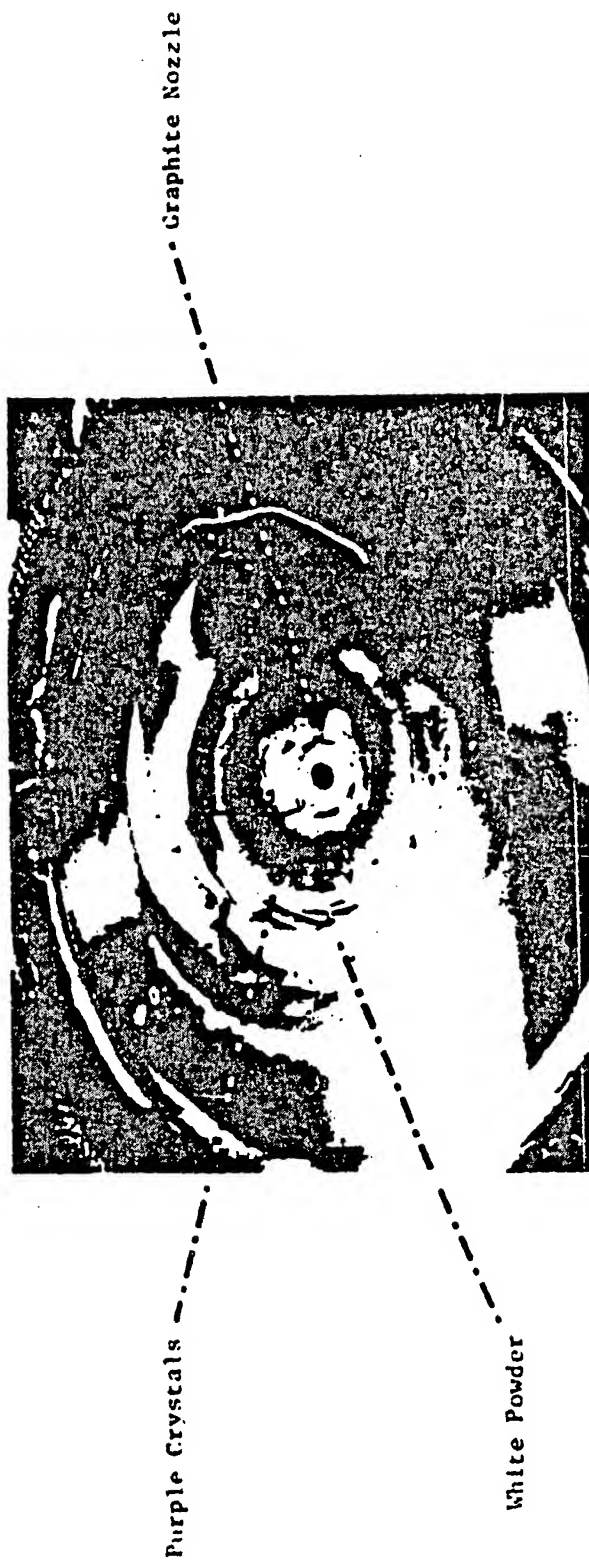


Figure 10. Plasma/Reactants Injection Flange After Experiment #1



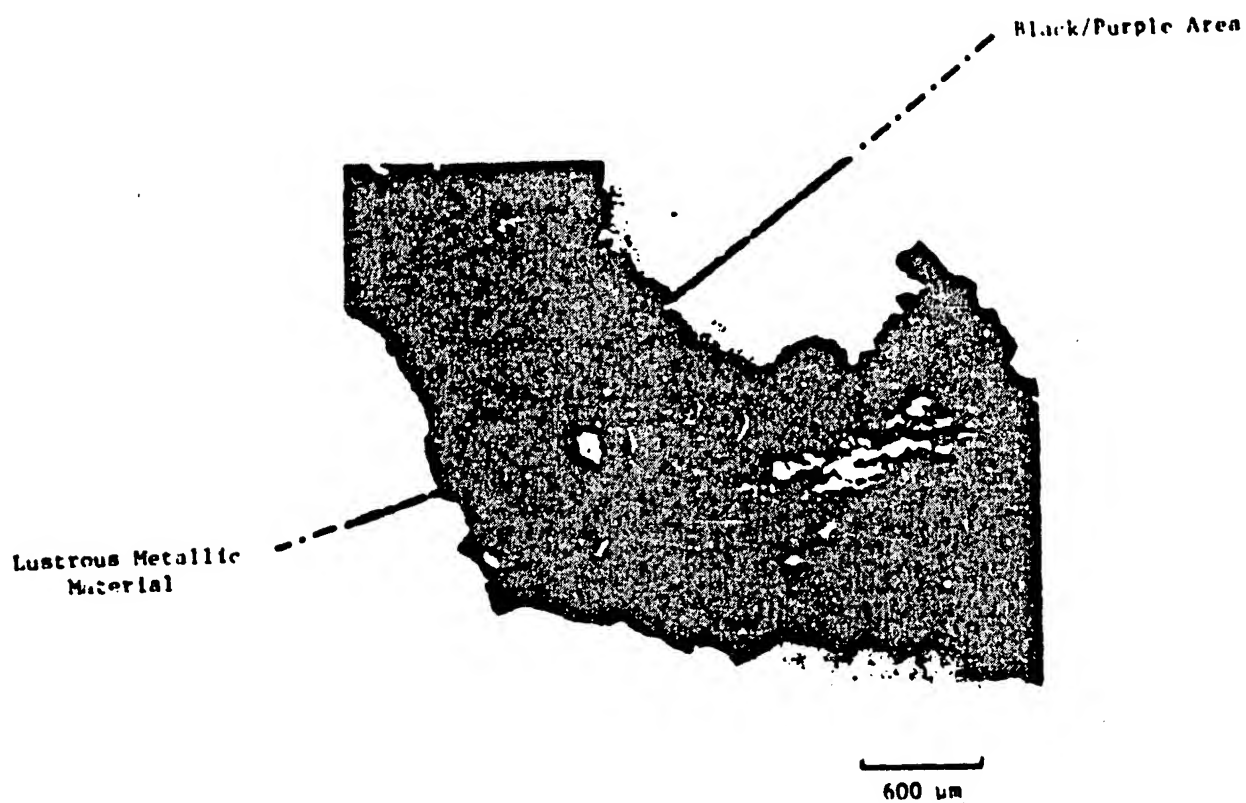
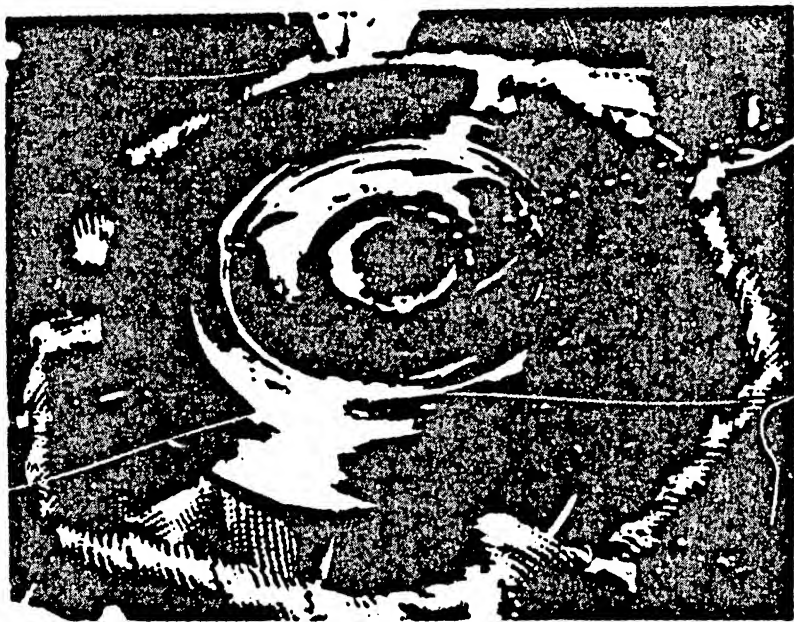


Figure 11. Optical Photograph of Titanium Product from Experiment #1



..... Titanium Powder

Figure 12. Plasma/Reactant Injection Flange after Experiment #2

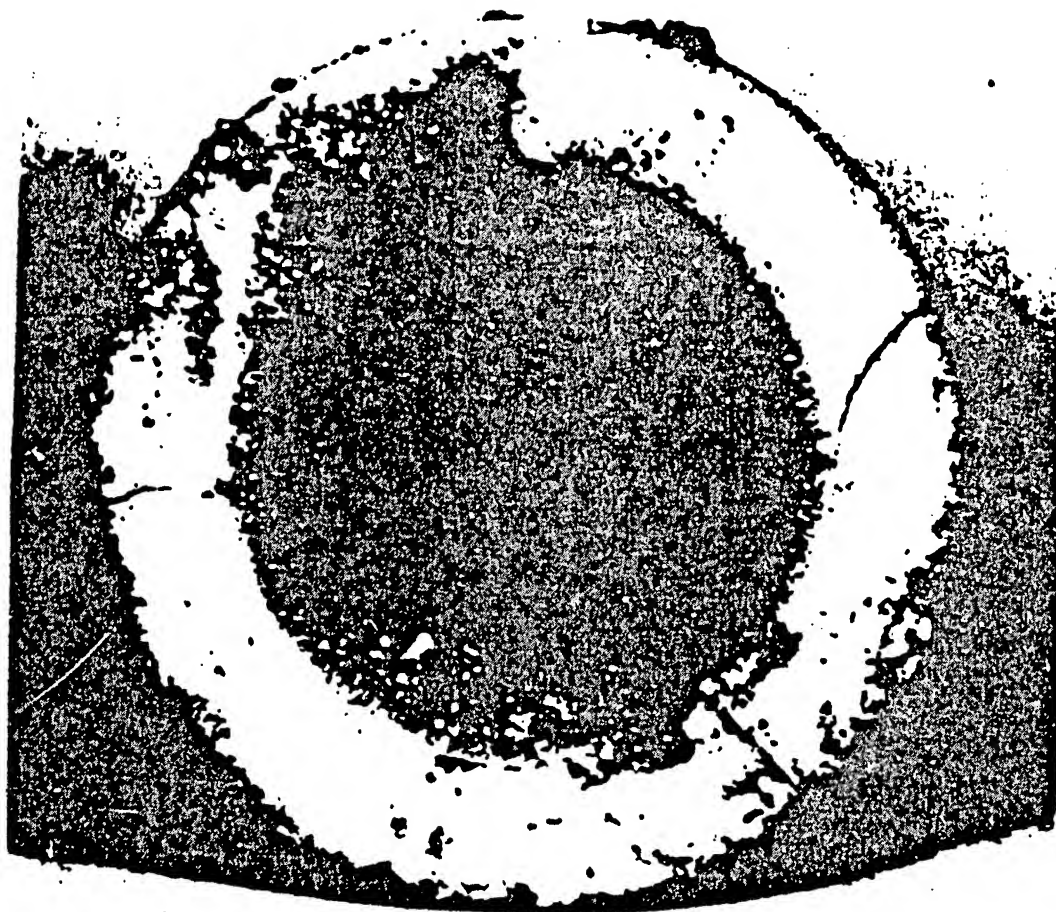


Figure 13. Silicon Carbide Reaction Tube (Hot End) after Experiment #2



Figure 14. Metallic Titanium Product from Experiment #2 (X100)



100 μm

TI

SPOT 1

116.6

SI 21

Figure 15. SEM/EDXA Analysis of Product from Experiment #1

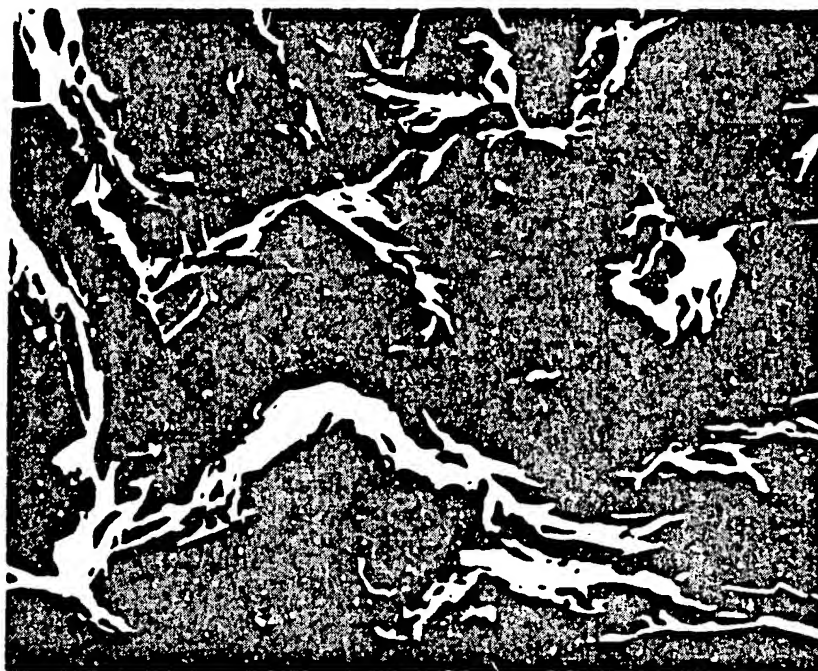


FIG 4,  
AREA SCAN

TI

SI

Figure 16. SEM/EDXA Analysis of Bulk Product from Experiment 2



PR= S 175EC 0 INT  
 U=4096 H=10KEV 1 10 AD=10KEV 10

FIG. 2, SPOT 1

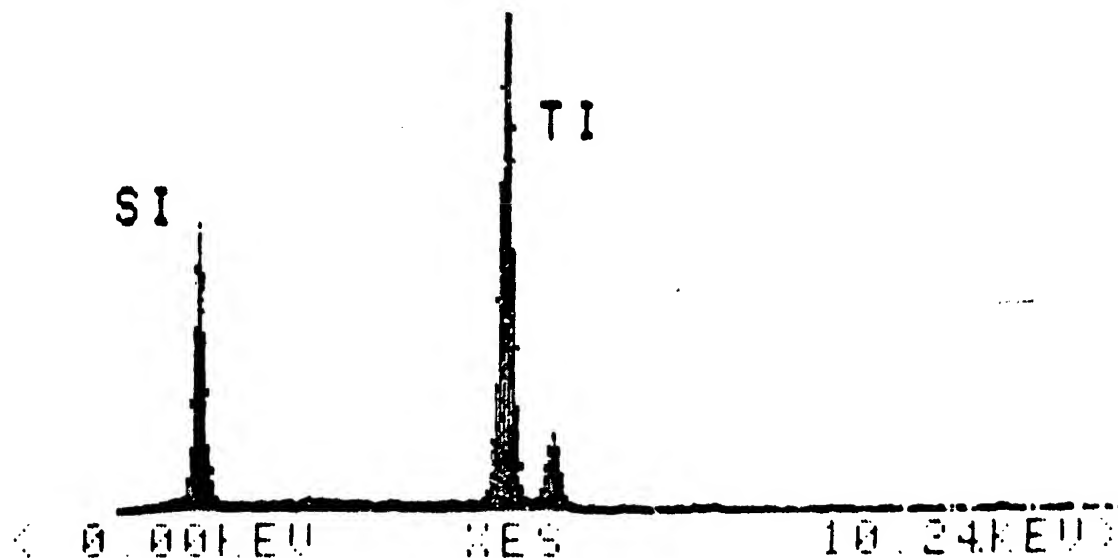
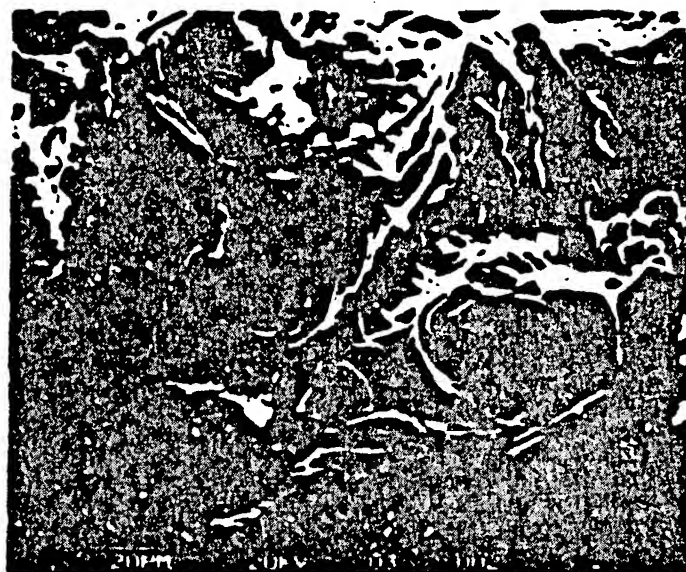


Figure 17. SEM/EDXA Analysis of Crystalline Product from Experiment #2





PP= 5 295ED 0 INT  
 U=2048 H=10KEV 1:30 AD=10KEV 10

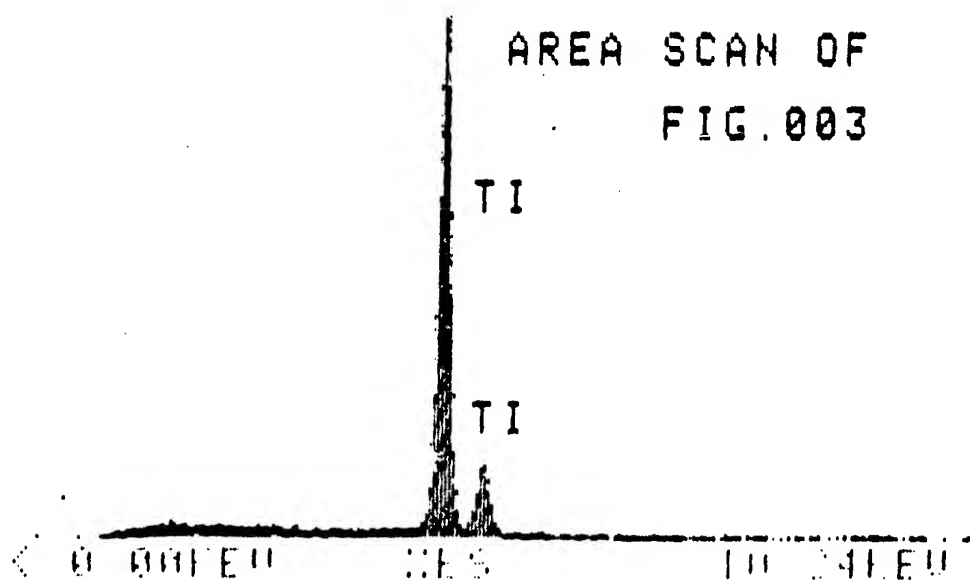


Figure 18. SEM/EDXA analysis of product from Experiment #5. (From first inch of graphite tube)



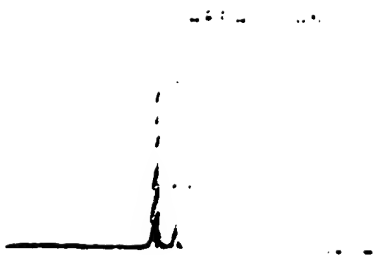
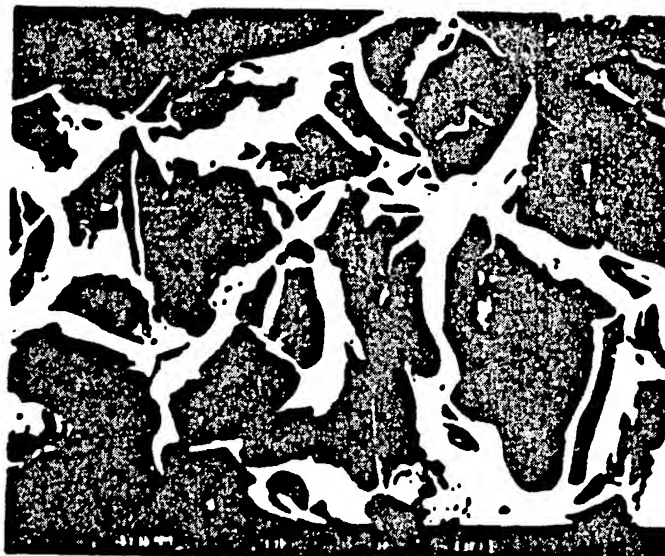
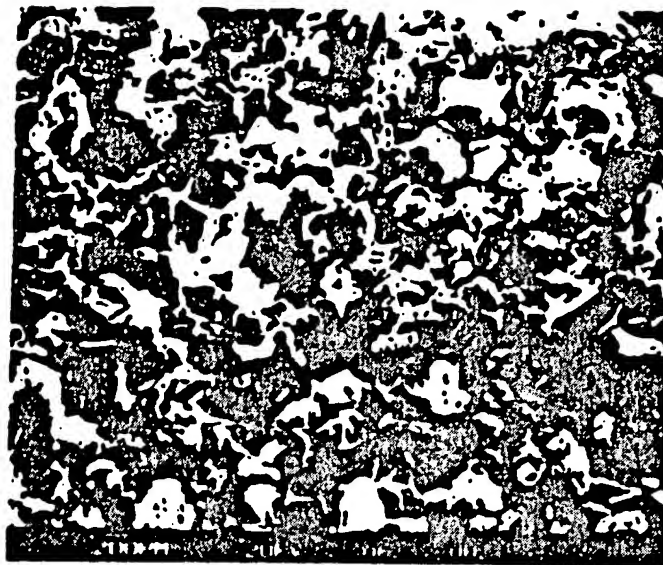
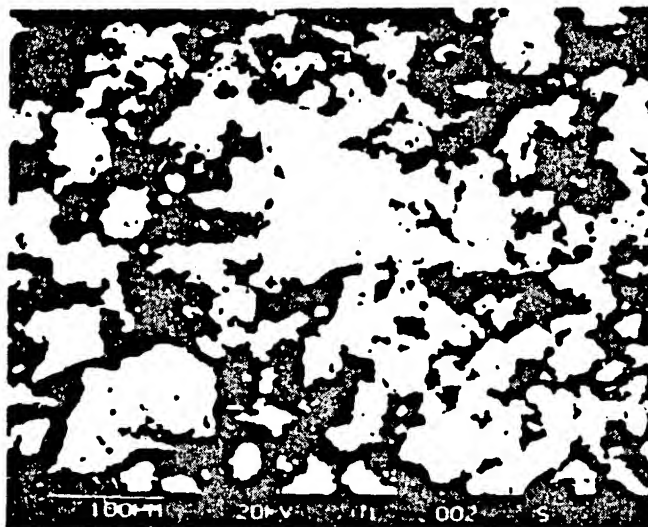


Figure 19. SEM/EDXA analysis of product from Experiment #5. (From first 6" of reaction tube)



PP 8 24SEL 0 INT  
 U=4096 H=10KEU 1:30 AQ=10KEU 10

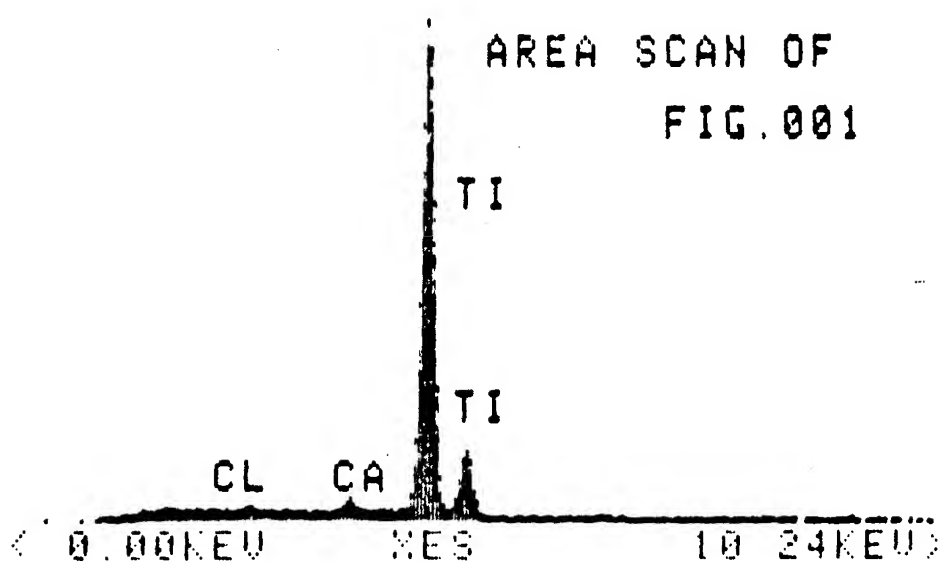


Figure 20. SEM/EDXA analysis of the ultrafine reaction product after leaching away NaCl and sodium - Experiment #5.



#1 Z=00  
 PR= S 23SEC 0 INT  
 U=2048 H=10KEV 4:40 AQ=10KEV 40

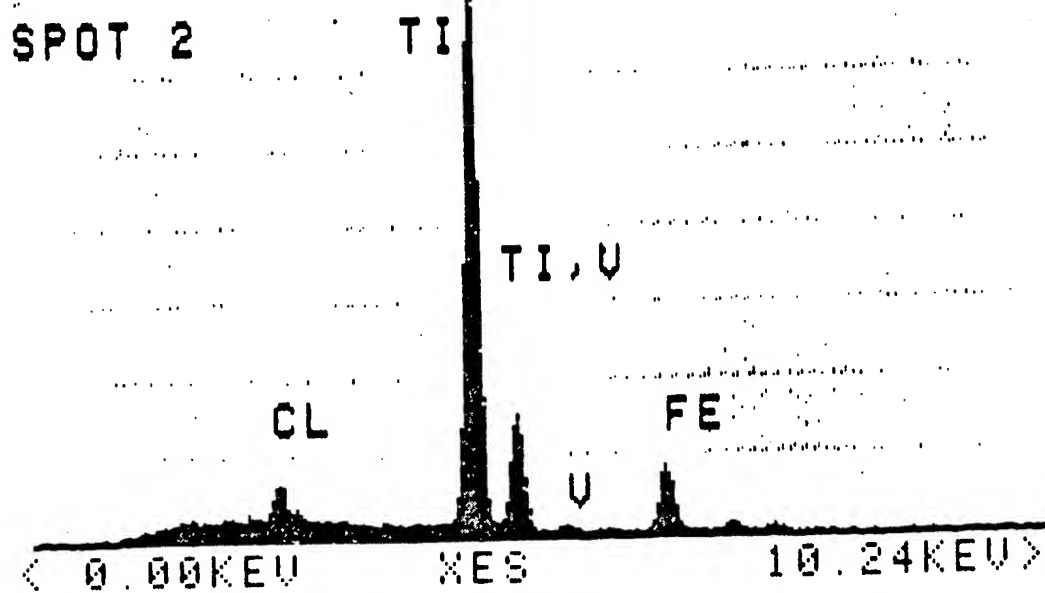


Figure 21. SEM/EDXA analysis of product from Experiment #6.  
 Titanium-rich area.

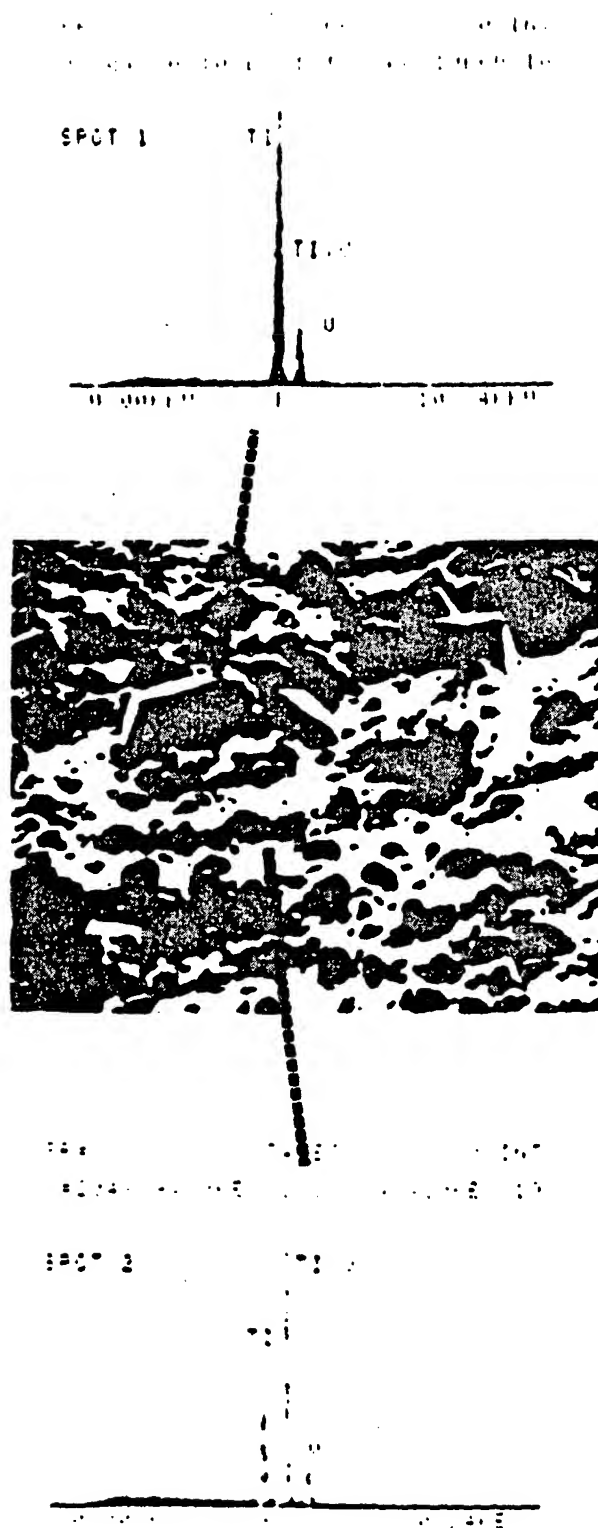


Figure 22. SEM/EDXA analysis of product from Experiment #6. Shows vanadium-rich substrate with titanium-rich crystals.

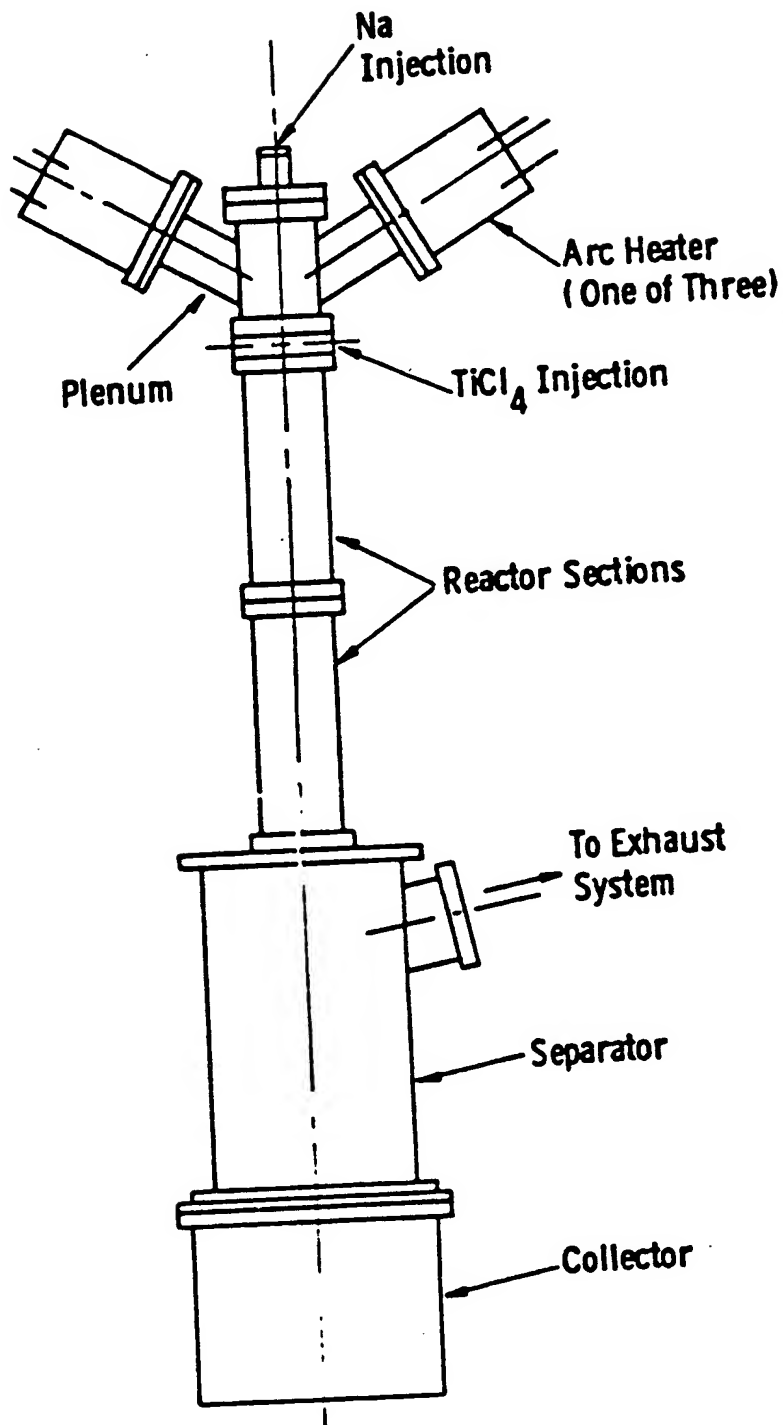


Fig. 23—Plasma reactor for titanium production

**END**

**FILMED**

**1-83**

**DTIC**